



UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
P.O. Box 1450
Alexandria, Virginia 22313-1450
www.uspto.gov

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/798,456	03/10/2004	Youngjin Choi	LAM1P187/P1216	6110
22434	7590	08/24/2006	EXAMINER	
BEYER WEAVER & THOMAS, LLP			UMEZ ERONINI, LYNETTE T	
P.O. BOX 70250			ART UNIT	
OAKLAND, CA 94612-0250			PAPER NUMBER	

1765

DATE MAILED: 08/24/2006

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary

Application No.

10/798,456

Applicant(s)

CHOI ET AL.

Examiner

Lynette T. Umez-Eronini

Art Unit

1765

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 09 June 2006.
- 2a) ☒ This action is **FINAL**. 2b) ☐ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1-5,8-15 and 18-26 is/are pending in the application.
- 4a) Of the above claim(s) _____ is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☒ Claim(s) 1-5,8-15 and 18-26 is/are rejected.
- 7) ☐ Claim(s) _____ is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on _____ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some * c) ☐ None of:
- ☐ Certified copies of the priority documents have been received.
 - ☐ Certified copies of the priority documents have been received in Application No. _____.
 - ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

- 1) ☒ Notice of References Cited (PTO-892)
- 2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
- 3) ☒ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08)
Paper No(s)/Mail Date 6/28/2006.
- 4) ☐ Interview Summary (PTO-413)
Paper No(s)/Mail Date. _____.
- 5) ☐ Notice of Informal Patent Application (PTO-152)
- 6) ☐ Other: _____.

DETAILED ACTION

Election/Restrictions

1. Applicant's election of Claims 1-18 and 18-20 in the reply filed on 6/9/2006 is acknowledged. Because applicant did not distinctly and specifically point out the supposed errors in the restriction requirement, the election has been treated as an election without traverse (MPEP § 818.03(a)).

Claim Rejections - 35 USC § 103

2. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

3. This application currently names joint inventors. In considering patentability of the claims under 35 U.S.C. 103(a), the examiner presumes that the subject matter of the various claims was commonly owned at the time any inventions covered therein were made absent any evidence to the contrary. Applicant is advised of the obligation under 37 CFR 1.56 to point out the inventor and invention dates of each claim that was not commonly owned at the time a later invention was made in order for the examiner to consider the applicability of 35 U.S.C. 103(c) and potential 35 U.S.C. 102(e), (f) or (g) prior art under 35 U.S.C. 103(a).

Art Unit: 1765

4. Claims 1, 2, 4-7, 13, 14, and 18-20 are rejected under 35 U.S.C. 103(a) as being unpatentable over Naeem et al. (US 5,846,884) in view of Hineman et al. (US 6,379,872 B1).

Naeem discloses a method for etching through a selected portion of a layer stack (Abstract), which comprises interlayer dielectric layer **102**, barrier layer **104**, metallization layer **106**, barrier layers **108** and **110**, anti-reflective coating layer **112**, and photoresist layer **114**. The ARC layer **112** may be organic in nature (column 1, lines 20-57). Naeem also discloses, "In step **302**, etching is preformed . . . using . . . gases such as N₂, . . . O₂, CHF₃, CF₄, CO and/or other suitable chemistry (column 6, lines 13). Naeem further discloses vertical etching through layers **112**, **110**, **105**, **104**, and **102** (column 2, lines 31-33). Layer **102** is typically silicon dioxide (same as Applicants' inorganic dielectric layer), (column 1, lines 26-28). The aforementioned reads on,

A method for etching an inorganic dielectric layer through a photoresist mask with an ARC layer between the layer to be etched and the photoresist mask over a substrate, comprising:

- placing the substrate into a processing chamber;

- providing an ARC open gas mixture into the processing chamber, wherein the ARC open gas mixture comprises:

- an etchant gas; and

- a polymerization gas comprising CO and CH₃F;

- forming an ARC open plasma from the ARC open gas mixture; etching the ARC layer with the ARC open plasma until the ARC layer is opened; and

Art Unit: 1765

etching the inorganic dielectric layer, **in claim 1**;

A method for forming a semiconductor device, comprising:

placing a layer to be etched over a substrate; forming an organic ARC layer over the layer to be etched; forming a photoresist mask over the ARC layer;

placing the substrate into a processing chamber;

providing an ARC open gas mixture into the processing chamber, wherein the ARC open gas mixture comprises:

an etchant gas; and

a polymerization gas comprising CO and CH₃F;

forming an ARC open plasma from the ARC open gas mixture;

etching the ARC layer with the ARC open plasma until the ARC layer is opened;

providing an etch plasma different than the ARC open plasma; and

etching the inorganic layer to be etched with the etch plasma, **in claim 18**;

wherein the ARC open gas mixture further comprises an etch rate booster, wherein the etch rate booster is O₂, **in claims 4 and 19**;

wherein the layer to be etched is a dielectric layer and wherein the etchant gas comprises at least one of an N₂ and H₂ mixture and CF₄, **in claim 5 and 20**;

further comprising providing a photoresist mask over the stack, **in claim 7**; and

wherein the inorganic dielectric layer is silicon oxide (column 1, lines 26-28), **in claim 23 and 24**.

Naeem differs in failing to teach stopping the ARC open gas mixture before the inorganic dielectric layer to be etched is completely etched, **in claim 1**; and stopping the

Art Unit: 1765

ARC open gas mixture, so that none of the layer to be etched is etched by the ARC open plasma, **in claim 18**.

Hineman teaches, "To provide a more uniform and predictable etch through the ARC **14**, two plasma etching processes are performed sequentially . . . the first plasma etch process should be halted before etching of the ARC **14** is completed . . . In general it is desirable to use the first plasma etch to etch as much of the ARC **14** as possible, but to stop the first plasma etch process prior to any etching of the (underlying layer) layer **12**" (column 3, lines 26-54).

Hineman illustrates stopping an ARC open gas mixture before the inorganic dielectric layer to be etched is completely etched, is known. Hence, it would have been obvious to one having ordinary skill in the art at the time the invention was made to modify Naeem by stopping the etching of an ARC open gas mixture for the purpose of uniformly etching through an ARC (Hineman, column 3, lines 26-27).

Since the combination of Naeem and Hineman teaches a similar method of etching the same materials as applicants, then using the said combination in the same manner as claimed by applicants would result the same wherein ARC open plasma highly selectively etches the ARC with respect to the layer to be etched, **as in claim 2**.

5. Claims 3 and 12 are rejected under 35 U.S.C. 103(a) as being unpatentable over Naeem (US '884) in view of Hineman (US '872 B1) as applied to claim 1 above, and further in view of Chen et al. (US 6,080,662).

Naeem in view of Hineman differ in failing to disclose wherein the flow rate of CO is at least 150 sccm, **in claims 3 and 12.**

Chen discloses, an etching process that uses 0-200 sccm of CO (Abstract).

Chen illustrates CO having a flow rate of at least 150 sccm is known. Hence, it would have been obvious to one having ordinary skill in the art at the time the invention was made to modify Naeem by selecting any flow rate of CO as taught in the Chen reference, including applicants' claimed flow rate, which would effectively accomplish the disclosed composition in an etching method because it has been held that there is no invention where the difference in proportions is not critical and was ascertained by routine experimentation because the determination of workable ranges is not considered inventive. See *In re Swain and Adams*, 70 USPQ 412 (CPA 1946).

6. Claim 8 and 10 are rejected under 35 U.S.C. 103(a) as being unpatentable over Naeem (US '884) in view of Hineman (US '872 B1) as applied to claim 1 above, and further in view of Angelopoulos et al. (US 6,316,167 B1).

Naeem in view of Hineman differ in failing to teach wherein the ARC layer is of an organic material and wherein the photoresist mask is of a 193 or higher generation photoresist, **in claim 8**; and wherein the ARC layer is of an organic material and wherein the photoresist mask is of a 193 or higher generation photoresist and wherein the ARC open plasma etches the ARC with respect to the layer to be etched with a selectivity greater than 50:1, **in claims 10, 11, and 15.**

Angelopoulos discloses, "A broad aspect of the present invention is a resist structure comprising a resist on top of a vapor deposited RCHX film . . . wherein the optical and chemical properties of the RCHX films are tuned to (1) provide suitable optical properties at the appropriate wavelength (248 nm, 193 nm, 157 nm, 126 nm and extreme ultraviolet radiation) to function as an ARC (2) not negatively interact with the resist inducing residue, footing or undercutting and (3) provides good etch selectivity to the resist." (column 5, line 66 – column 6, line 10).

Angelopoulos also teaches using the RCHX film as a replacement to conventional bottom ARC in a conventional stack as shown in FIG. 11 (column 7, lines 24-26).

Angelopoulos illustrates an ARC of an organic material having a photoresist mask of 193 nm or higher and the layer to be etching is silicon oxide is known.

Hence, it would have been obvious to one having ordinary skill in the art at the time the invention was made to modify Naeem in view of Hineman by using an ARC of an organic material having a photoresist mask of 193 nm or higher and the layer to be etching is silicon oxide for the purpose of providing good etch selectivity to the resist (Angelopoulos, column 6, line 5-10).

Since the combination of Naeem in view of Hineman and further in view of Angelopoulos teaches a similar method of etching as claimed by applicants, then using the said combination in the same manner as the claimed invention would result the

Art Unit: 1765

same wherein the ARC open plasma etches the ARC with respect to the layer to be etched with a selectivity greater than 50:1.

7. Claims 21, 22, 25, and 26 are rejected under 35 U.S.C. 103(a) as being unpatentable over Naeem (US '884) in view of Hineman et al. (US '872 B1). as applied to claims 1, 2, 4-7, 13, 14, and 18-20, above, and further in view of Hills et al. (US 6,217,786 B1).

Naeem in view of Hineman differs in failing to teach providing power of 0-1000 Watts at 27 MHz and 100-1000 Watts at 2MHz, **in claim 21;**

wherein the temperature within said chamber is between -20 and 40°C, **in claim 22;** and

setting the pressure within said processing chamber at between 200 and 300 mTorr, **in claims 25 and 26.**

Hills discloses, "Exemplary Etching Parameters: Approximate Range Parameters Electrostatic Chuck (-20)-(40) °C., 20 °C. Temperature: Top Electrode Temperature: 0-60°C. 40 °C. Bottom Power (2 MHz) 0-2500 watts 2200 W Top Power (27 MHz) 0-2500 watts 1200 W ESC He Pressure 5-30 Torr 15 Torr Chamber Pressure 10-250 mTorr 67 mTorr Electrode Gap 1-4 cm 1.3 cm Top Electrode Frequency 13-40 MHz 27 MHz Bottom Electrode Frequency 1-4 MHz 2 MHz " (column 6, lines 16-54), which reads on Applicants' specifically process parameters as recited in the claims.

Hills illustrates Applicants' specifically process parameters is known.

Hence it would have been obvious to one having ordinary skill in the art at the time the invention was made to modify Naeem in view of Hineman by using Hills's

Art Unit: 1765

process parameters for the purpose of achieving a substantially straight vertical profile of an opening in an oxide layer while maintaining critical dimension control (Hills, column 3, lines 36-38-41).

Response to Arguments

8. Applicant's arguments with respect to claims 1-5, 8-15, and 18-26 have been considered but are moot in view of the new ground(s) of rejection because the former prior art of record failed to address: "A method for etching --an inorganic dielectric— layer . . ." as recited in (Currently Amended) Claims 1 and 18 and the limitations in (New) Claims 21-26.

Conclusion

9. Applicant's amendment necessitated the new ground(s) of rejection presented in this Office action. Accordingly, **THIS ACTION IS MADE FINAL**. See MPEP § 706.07(a). Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of

Art Unit: 1765

the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the date of this final action.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Lynette T. Umez-Eronini whose telephone number is 571-272-1470. The examiner is normally unavailable on the First Friday.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Nadine Norton can be reached on 571-272-1465. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

Art Unit 1765

ltue

August 17, 2006

NADINE NORTON
SUPERVISORY PATENT EXAMINER
ART UNIT 1765
